Name: Cora James

Course/Grade: Astronomy mixed elective class of 10th-12th grade students

Lesson Title: Using Radio Astronomy to Explore the EMS

The intent of this unit is to introduce the electromagnetic spectrum to students with an emphasis on how we use it to explore our universe. They will also explore how the EMS has allowed us to better understand our place within the universe.

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| **Stage 1 Desired Results** | | |
| ESTABLISHED GOALS  Students will understand how the EMS is used by various telescopes to collect data  Students will understand the necessity of global cooperation to analyze and interpret the data ,including associations with other satellite imagery  Students will deepen their understanding of the nature of sciences as they explore the sub-culture that connects all astronomers, as well as scientists of other disciplines.  Students will establish a global perspective on why space exploration is valued as a common human goal that unites all cultures.  Students will understand project approval process as it pertains to which astronomer projects are selected to have instrument time. This is a globally competitive process. | ***Transfer*** | |
| *Students will be able to independently use their learning to…*  Apply their knowledge gained to scientific collaborations regardless of discipline  Develop an global appreciation of human existence as people collaborate globally to understand their place in the universe.  Develop an appreciation of the scientific sub culture astronomers belong to worldwide, regardless of nationality or origin country. | |
| ***Meaning*** | |
| UNDERSTANDINGS  *Students will understand that…*  The EMS is a broad tool used to study many different topics.  Astronomical instruments are conglomerate of multinational teems with the cooperation of the home country. Development funding translates into project time once the instrument is complete. Projects are allowed based on the overall goals of the instrument and the scientific worthiness.  Science is a conglomerate of individuals that work together towards deepening our understanding and adding to a vast body of knowledge. This group comprises its own-subculture that extends beyond borders or national ties.  Students can contribute to current and ongoing research by participating in projects like Galaxy Zoo which enable citizen data analysis for use by researchers. | ESSENTIAL QUESTIONS  How can we use the EMS to study objects in space?    Who builds these expensive instruments?  How is it decided who gets to use them for research?  What are the goals of the new southern radio telescope, and other EMS collection instruments?  How does the search for knowledge unite people on a global scale?  How has globalization affected scientific research?  Can citizens (students) contribute to scientific research? |
| ***Acquisition*** | |
| *Students will know…*  How a radio telescope works within the EMS  How decisions are made on what to research  How running such an instrument is a global collaboration.  The various aspects of the EMS  That they can contribute to scientific research and become a part of the scientific cultural community. | *Students will be skilled at…*  Analysis of the EMS  Interpreting radio satellite and other EMS acquired data.  Identifying galaxy types from data analysis on Galaxy Zoo.  Understanding how globalization affects scientific research and the sub-culture in which astronomers interact on a global scale |
| **Stage 2 - Evidence** | | |
| **Evaluative Criteria** | **Assessment Evidence** | |
| Presentations contain necessary information and students demonstrate knowledge of information. Information is accurate, informative, relevant and creative.  Presentations make a connection to multiple aspects of globalization enabled by technology and how this relates to furthering scientific understanding.. | TRANSFER TASK(S):  Student groups of 2 students will be assigned with one of four research topics. Each group will be charges with generating 3 page power point presentation over their topic.  Topic 1 How exactly does a radio telescope collect data?  Topic 2 how and why was this location chosen to build this array?  What is the importance of global geographic position?  Topic 3 What other arrays are in use globally?  What is their global position and why was it chosen?  Topic 4 What countries collaborated on this project and what did each contribute to the project?  Why is it necessary to collaborate with other countries?  How has globalization and technology made this possible?  What is a scientific subculture and how does this unite researchers globally?  How is the subculture enable greater progress when trying to develop understanding and research?  After student groups have completed their research they will for expert committees (combine with other student groups that had the same topic) and develop a presentation to present to the class. | |
| Students grasp the intent of the research the image represents with an understanding of the international effort of collaboration  This citizen science project will enable them to participate in astronomy research/data analysis and engage them in the culture of scientific research. | OTHER EVIDENCE:  Students will choose an image of an object in space beyond our solar system. They will show their image in class and explain to the class how the image was created.  To include discussion of instrument he image was taken with  What aspect of the EMS was utilized and how (discuss instrument collection ability). Real color or false color assignments?  What information was gained from this image?  What was the goal of the researcher (or researchers) that conducted this study?  What was their country of origin of the researcher, who controls the satellite, and how is researcher time awarded?  Students will do the tutorial on Galaxy Zoo that enables them to identify galaxy types and catalog them as part of a large data collection effort. | |
| **Stage 3 – Learning Plan** | | |
| *Summary of Key Learning Events and Instruction*   * Introduction to radio astronomy with NASA ESA pod cast about development of a new observatory in the southern hemisphere.   Students will be introduces to the false color imagery produces from the analysis of data acquired with radio telescopes   * Instructor led presentation over the EMS that will include historical developments that have contributed to current understanding. An emphasis on the various cultures that have contributed knowledge will be incorporated. This will include present day understanding of gravity waves and a class discussion on if gravity waves exist. * Students will individually explore the NASA Mission Science page that introduces the EMS. They will have a focused web quest activity that asks them to explore different aspects of these pages. * Review page over this information to reinforce new content knowledge. * Students will read latest articles on gravity waves. This will include a discussion of the author, location of the research, collaborators, and the findings of the research. * Student reports over the information gathered in the group assignment over radio astronomy. One topic will be presented each day wit the student experts introducing information that generates class discussion. Teacher questions will be used to stimulate discussion as needed. Students will summarize the content after agreement is reached about discussed material. (3 or 4 days) * Teacher led introduction to other EMS instruments used in astronomy. Students will them select images to research and briefly summarize their findings to the class including the criteria mentioned above. * Class will be asked to examine their ideas about the place of space exploration in society and its value with regards to a global perspective. This aspect of the project will have a globally cosmopolitan viewpoint of scientific research as we analyze the implications of astronomical discoveries on global perspectives and knowledge. * Students will participate in the Galaxy Zoo citizen science research program that allows everyday citizens to analyze Hubble images and determine galaxy types as part of ongoing research/data analysis. | | |
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